National Park Service
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Natural Resource Program Center

SOP for Conducting Coastline Surveys of Birds and Mammals, Animal Carcasses, Debris and Other Resources – Version 1.1

Southwest Alaska Inventory and Monitoring Network

Natural Resource Report NPS/SWAN/NRR—2011/396

ON THE COVER
Hallo Bay Beach
Photograph by: Alan Bennett, KATM

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Natural Resource Report NPS/SWAN/NRR—2011/396

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Revision History Log

All edits and amendments made to this document since its inception should be recorded in the table below. Users of this protocol should promptly notify the project leader of the marine nearshore monitoring program of recommended edits or changes. The project leader will review and incorporate suggested changes as necessary, record these changes in the revision history log, and modify the date and version number on the title page of this document to reflect these changes.

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
Version 1	08/16/2010	Coletti	Formatting; updating to reflect SWAN	To meet NRR standards, remove NGEM references	1.1
Add rows as needed for each change or set of changes associated with each version.					

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1 Background and Objectives

This SOP was peer reviewed, but never fully implemented

1.1 Introduction
Collecting observational data while walking beaches has proven useful in monitoring change in the marine environment. Beach surveys have been used to document patterns in the distribution and relative abundance of birds and mammals closely associated with marine shorelines, carcasses of marine birds and mammals, and debris on beaches. The utility of shoreline survey data is exemplified by collections of sea otter carcasses from beaches in Prince William Sound that have been made for over a decade (Monson et al. 2000), teeth extracted from the skulls of sea otters have been used to provide age estimates for sea otters, and the age-at-death data have been modeled to provide histories of sea otter survival rates. These data were used to document and quantify chronic effects of oiling on sea otter survival following the Exxon Valdez oil spill. Other coastline survey observations include the documentation of die offs of marine birds or other marine life. Beached bird surveys have been conducted worldwide (e.g.,www.tufts.edu/vet/seanet/index.html, www.bsc-eoc.org/regional/bcbeachbird.html) to examine the impacts of oil spills (e.g. Dahlmann et al. 1994, Camphuysen 1997, 2001) and other pollution events. In addition, collection of items spilled from cargo ships have been used to track ocean currents (www.afsc.noaa.gov/refm/docs/oscurs/get_to_know.htm). Other uses of shoreline survey data include documentation of changes in human use patterns and potential threats to marine life and beach esthetics from beached debris, documentation of spawning by marine animals, assessment of changes in beach geomorphology, and documentation of unusual events that may occur.

1.2 Rationale for collecting sea otter foraging data
Here we describe procedures for coastline surveys to be conducted each year within the Gulf of Alaska. These surveys are to be conducted by having observers walk designated segments of the coastline in the Gulf of Alaska each spring; recording the relative abundance of birds and mammal species that are closely associated with the shoreline; documenting the location and types of dead organisms, human activities, beached debris, and herring spawn; collecting sea otter skulls for laboratory analysis of age-at-death; and noting changes in coastline geomorphology. Over time, the results of these surveys will assist in the detection of changes in the marine ecosystem of the Gulf of Alaska. Systematic visits to the same shoreline segments over long periods of time afford the ability to document changes in species composition, patterns of human use, and changes in shoreline geomorphology. These data can then be used to assess the extent of change in the nearshore zone and relate change to natural or anthropogenic perturbations such as earthquakes, global climate change, or oil-spills. These procedures described herein are modified from surveys of beach-cast sea otters conducted in Prince William Sound by the US Geological Survey (Monson et al. 2000) and volunteer-based coastline surveys conducted in Kachemak Bay, Lower Cook Inlet Alaska (Center for Alaskan Coastal Studies 2004) and elsewhere (SEA net 2005,www.tufts.edu/vet/seanet/index.html).

1.3 Measurable Objective
The specific objectives of these shoreline surveys are:

- Document large-scale changes in abundance and distribution of bird and mammal species closely associated with the shoreline.
- Identify possible invasive species and regional shifts in species distributions by documenting the occurrence and or disappearance of plant and animal species in the local flora and fauna.
- Document anomalous large-scale die offs of birds, mammals, and invertebrates and suggest possible causes for die offs.
- Describe temporal and spatial patterns in survival rates of sea otters using estimates of age-at-death based on collections of beach-cast sea otter carcasses.
- Document changes in patterns of human-use based on direct observation of use and on surveys of the amount and type of debris on beaches.
- Identify temporal and spatial changes in herring spawning success by documenting the location and extent of herring spawn on beaches.
- Assist in development of models of ocean currents by documenting the time and location of discovery of materials spilled from cargo ships.
- Document large-scale changes in beach geomorphology (e.g. erosion of shorelines, landslides, or shifts in elevation due to earthquakes) that may impact nearshore marine life.

2 Sampling Design

2.1 Rationale for Selecting this Sampling Design over Others

Sampling is to be conducted using a geographically stratified repeated measures design, with sampling conducted on an annual basis within selected areas within each of four regions of the Gulf of Alaska (GOA): Prince William Sound (PWS), Kenai Peninsula (KP), Alaska Peninsula (AP), and the Kodiak archipelago (KOD) (see figure 1).

A proportion of the designated area is to be surveyed by volunteers. As a result, the selected sampling areas are largely concentrated around population centers or are in areas that can be accessed with relative ease. These are not random samples of Gulf of Alaska (GOA) coastline. As a result statistical inferences with respect to spatial and temporal patterns can be made only to the areas sampled and not to the larger GOA area. However, the data compiled from these surveys should prove as valuable indices of change within the GOA. Censusing the entire GOA coastline or sampling of randomized blocks within each region is impractical based on both logistical and cost constraints.

The survey work is to be conducted by professional marine ecologists, trained volunteer naturalists, and in some cases, relatively untrained volunteers such as youth groups. As a result, the protocols described here are broken into three tiers. Tier I describes survey methodologies that can be used by all surveyors after a brief (one day) training session. Tier II describes tasks that can be done either by scientists or by more highly trained or experienced volunteers. It is anticipated that a training session of several days and or demonstration of proficiency with respect to identification of birds, marine mammals, selected marine invertebrates, and selected marine plants will be required in order to conduct Tier II surveys. Tier III tasks are to be conducted only by highly trained scientists with specific training on, for example, necropsy methods for marine mammals.

2.2 Choosing Sampling Units

Surveys will be conducted at four locations in the Gulf of Alaska. These include specific beaches in western Prince William Sound, Kenai Peninsula, the Alaska Peninsula, and the Kodiak archipelago. Beaches in Prince William Sound include Green Island, the barrier islands near Green Island, Little Green Island, and specified segments of Latouche Island that have been surveyed on a regular basis over the past 27 years to determine age at death of sea otters (Figure 2a-d). Specific beaches on the Kenai Peninsula include those in Kachemak Bay that have been surveyed over the past 20 years by the Center for Alaskan Coastal Studies (CACS). It is anticipated that additional beach segments to be surveyed, both within these regions as well as on the Alaska Peninsula and the within Kodiak Archipelago, will be identified at a later date. Selection of segments will follow an initial survey to determine which beach segments can be efficiently surveyed by foot.

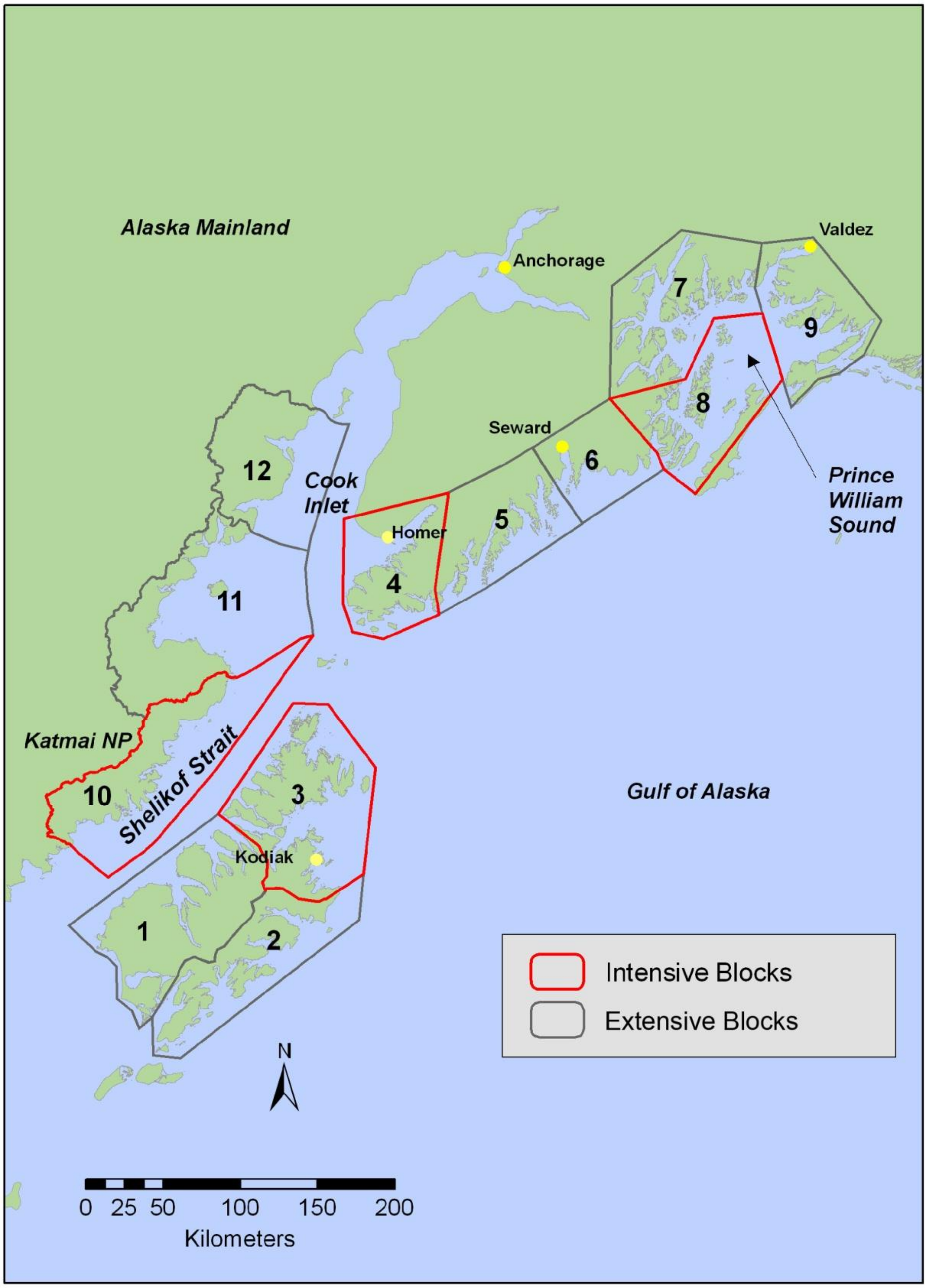

Figure 1. Location of intensive and extensive blocks within each of the 4 Nearshore REM Regions: Kodiak archipelago (KOD) Blocks 1, 2, 3; Alaska Peninsula (AP) Blocks 10, 11, 12; Kenai Peninsula (KP) Blocks 4, 5, 6 and Prince William Sound (PWS) Blocks 7, 8, 9

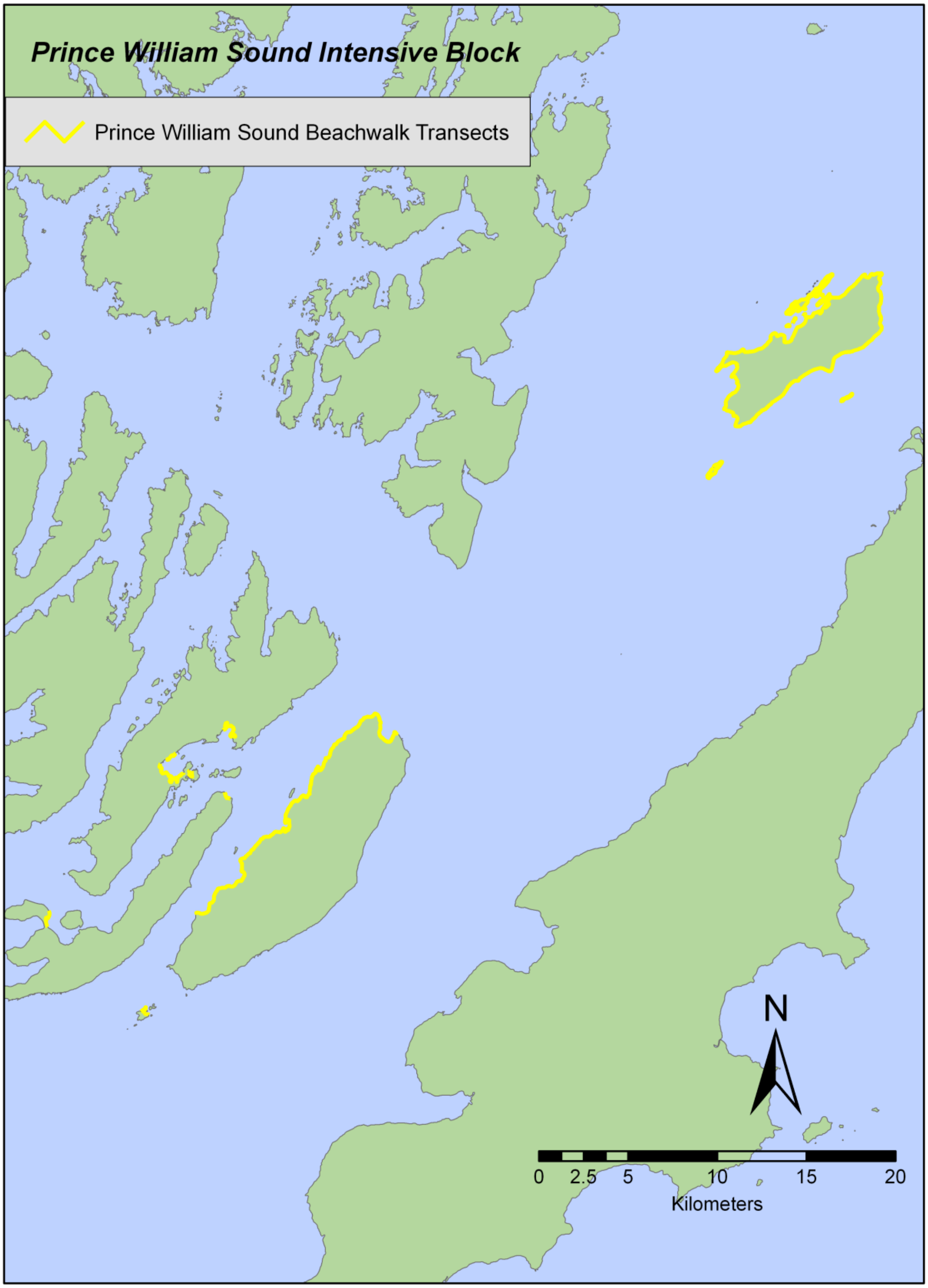

Figure 2a. Overview of Prince William Sound intensive block 8 beachwalk transects 1-17.

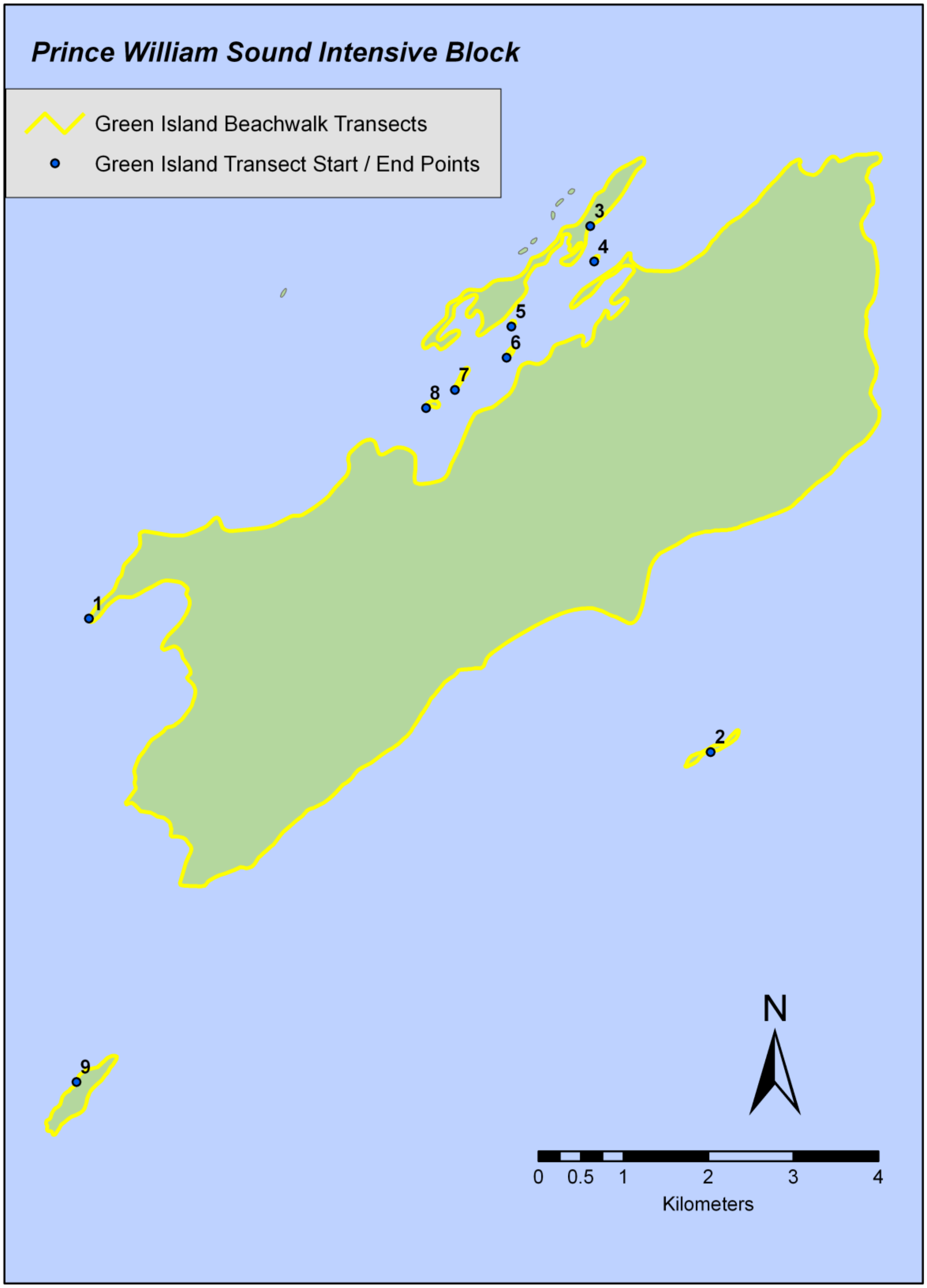

Figure 2b. Prince William Sound intensive block 8 Green Island beachwalk transects 1-9.

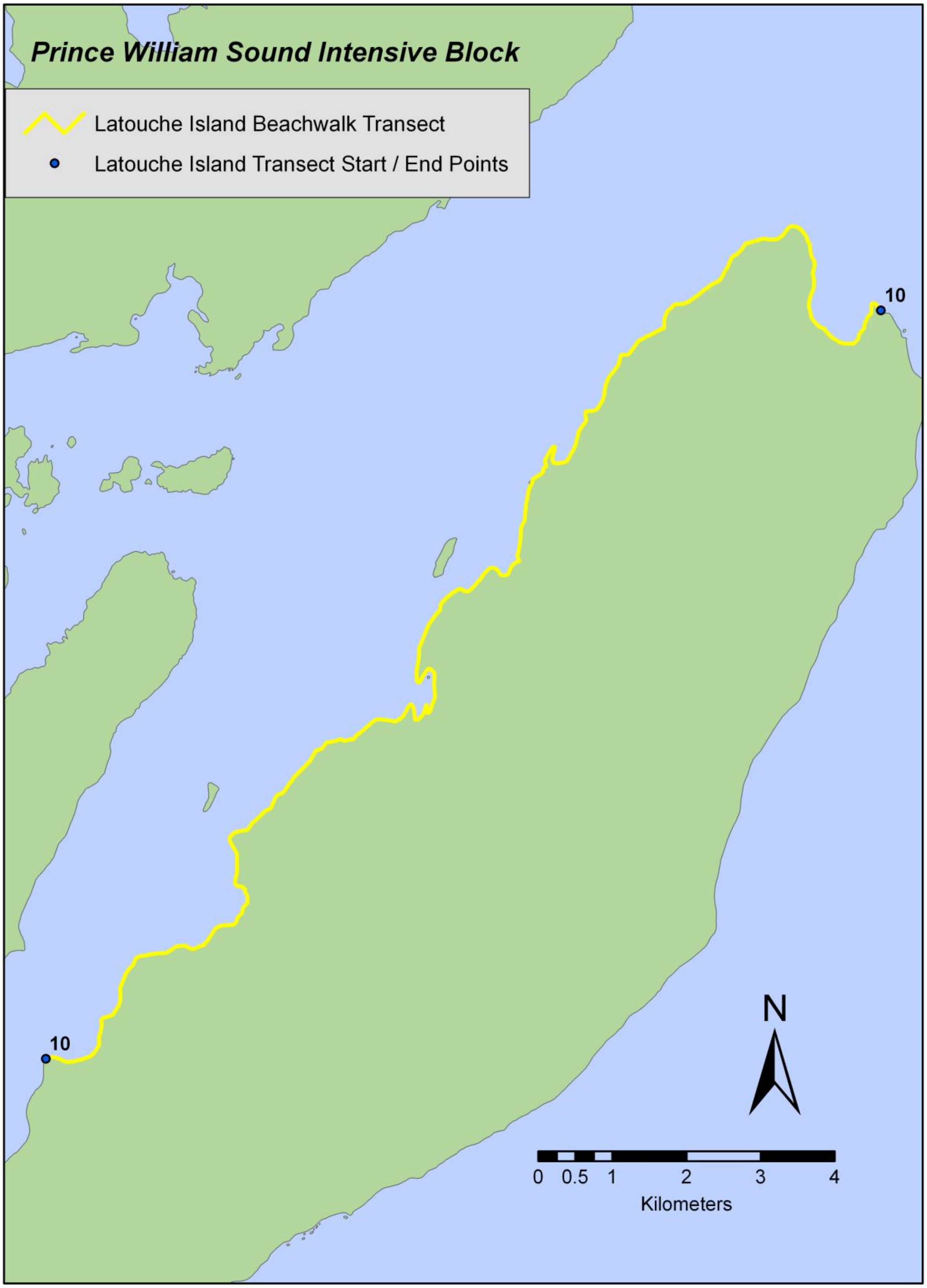

Figure 2c. Prince William Sound intensive block 8 Latouche Island beachwalk transect 10.

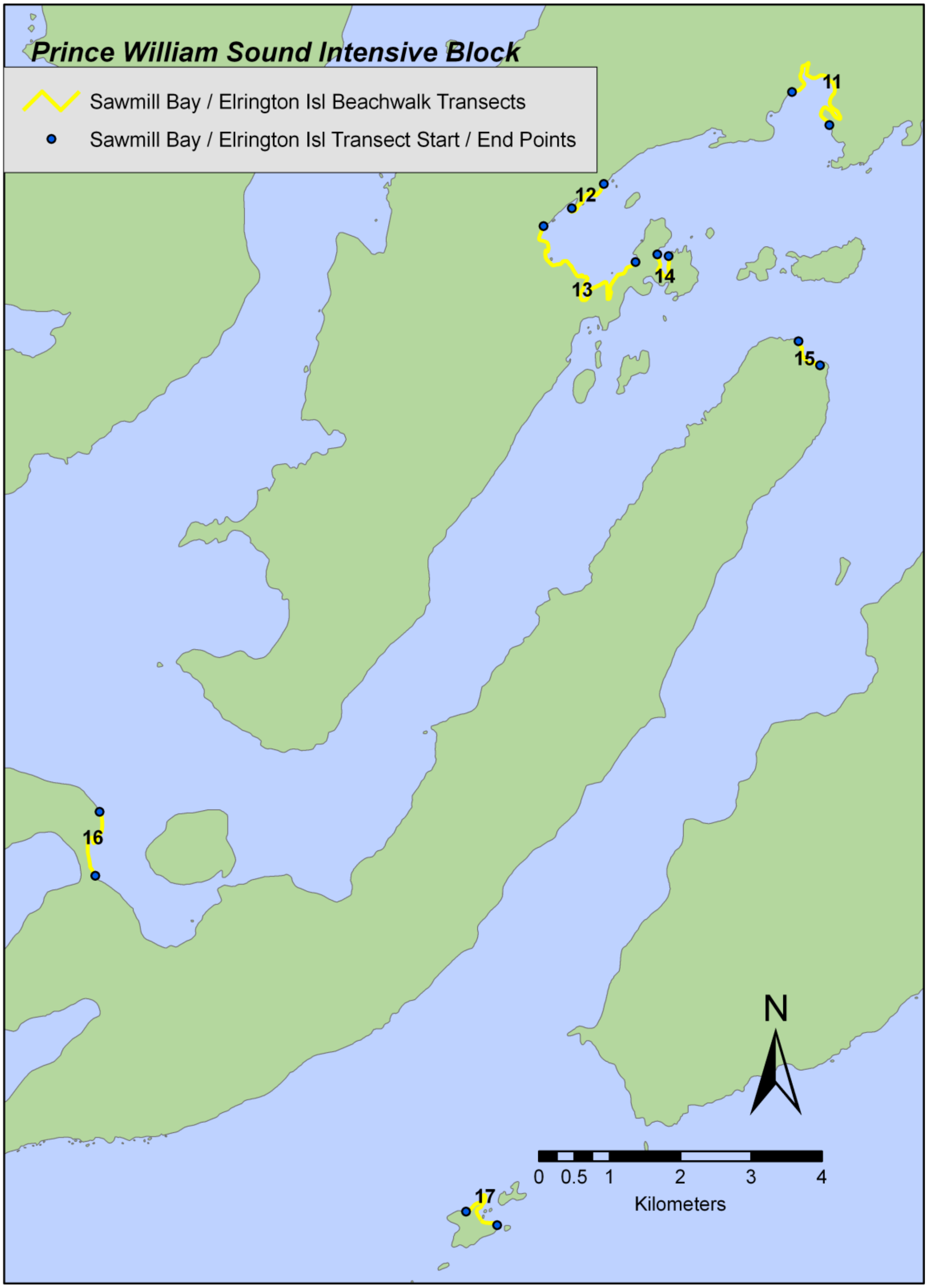

Figure 2d. Prince William Sound intensive block 8 beachwalk transects from Sawmill Bay, Elrington Island, and Danger Island. Sawmill Bay includes transects 11-14, Elrington Island includes 15-16, and Danger Island includes transect 17.

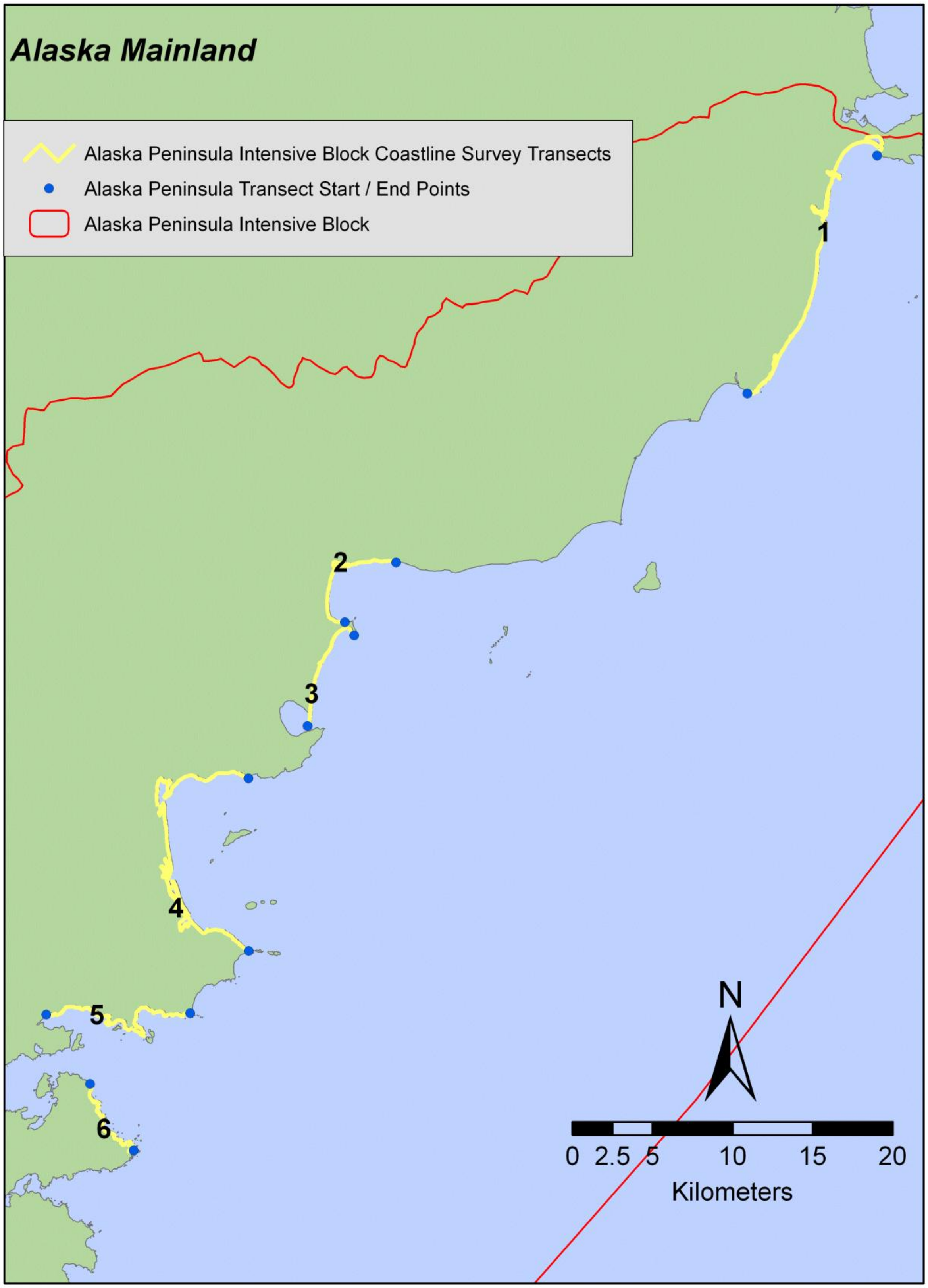

Figure 3. Alaska Peninsula intensive block 10.

2.3 Recommended Frequency and Timing of Sampling

(see N-REM section 2.8) – If possible, surveys are to be conducted at a minimum of once each year during late April or early May, after snow melt but prior to summer re-vegetation. Spring sampling allows carcasses and beach-cast debris to be observed before being subjected to scavenger pressure that increases as the weather warms. Also, spring surveys allow for observation to be made prior to a cover of shorelines by dense vegetation. The spring survey dates are to coincide with time of spawning by herring (mid to late April) if possible.

2.4 Level of Change that can be Detected

The levels of change that one might expect to be able to detect with the above survey design vary with metric and with region. For each metric, the effect size (the level of detectable change) depends in part on the number of surveys conducted and on the "normal" annual variation for that metric. With the exception of sea otter survival rates, there are insufficient data to determine levels of change that might be detected. For sea otter survival, researchers using methodologies identical to those described herein were able to detect a significant change in the age-frequency distribution of dead sea otters (represented by an approximate doubling of the frequency of one to six-year old sea otters in the dead population) in Prince William Sound following the Exxon Valdez oil spill based on 9 pre-spill and 2 post-spill surveys (Monson et al. 2000). Thus, we anticipate that we will be able to detect a similar magnitude of change (10-20%) in age distributions of sea otters found dead on beaches in Prince William Sound based on only two post-change surveys with similar effect sizes. Effect sizes for sea otter age-at-death distributions in other regions will depend on the number of skulls collected and normal variation in area-specific patterns of mortality and can not be predicted at this time.

We recommend that levels of detectable change be evaluated after an initial five years of the program. In general, it is the goal of the program is to detect a 50% reduction, or a 100% increase in a given metric within a five year period after the change has initially occurred. However, the value of a particular survey methodology can not be evaluated solely on this basis. For example, the detection of invasive species can not easily be evaluated based on these criteria. Similarly, the value of using observations of beached debris to aid in evaluating changes in human use patterns or ocean currents may not be adequately assessed by analyses that indicate detectable levels of change.

3 Field Season

3.1 Observation conditions

3.2 General methods

The coastlines to be surveyed within each region are divided into segments of approximately 1 to 30 km that are easily distinguished by geomorphologic features (e.g. point to point, see tables 1 and 2). The start and endpoints of each shoreline segment are to be identified by latitude and longitude (decimal degrees, NAD 83 or WGS84 datum) as recorded using a GPS (see appendix C) or estimated based on map coordinates. Each segment will be identified by a predetermined numbering system indicating the region (e.g. PWS, KP, AP, or KOD) and segment number (1…n).

Surveys will conducted by crews of two or more people walking along the selected coastline segments and searching between the water line and the storm tide line. At least one member of each crew should have experience in beach surveys from previous field seasons. Generally, the search effort will focus on the high tide line and the storm tide line where there is a wrack line and where skeletal remains and beached debris are often found, while the lower beach is scanned for live birds and marine mammals and freshly deposited carcasses. Efforts should be made to check behind large beached logs and other objects which can easily trap debris or carcasses as waves wash over them.

Table 1. Prince William Sound intensive block 8 beachwalks transects 1-17 start and end points with latitude and longitude in NAD 83 zone 6

TRANSECT #	LENGTH KM	TRANSECT NAME	LON_DMS	LAT_DMS	START / END	AREA
1	36.312	PWS_B8_BEACHWALKS_TX01	W147º 30´ 32.25"	N60º 15´ 15.49"	NA	Green Isl
2	1.602	PWS_B8_BEACHWALKS_TX02	W147º 22´ 35.83"	N60º 14´ 26.4"	NA	Green Isl
3	10.211	PWS_B8_BEACHWALKS_TX03	W147º 24´ 10.36"	N60º 17´ 45.91"	NA	Green Isl
4	0.203	PWS_B8_BEACHWALKS_TX04	W147º 24´ 07.14"	N60º 17´ 32.44"	NA	Green Isl
5	0.201	PWS_B8_BEACHWALKS_TX05	W147º 25´ 10.18"	N60º 17´ 07.58"	NA	Green Isl
6	0.320	PWS_B8_BEACHWALKS_TX06	W147º 25´ 13.81"	N60º 16´ 55.74"	NA	Green Isl
7	0.654	PWS_B8_BEACHWALKS_TX07	W147º 25´ 53.29"	N60º 16´ 43.39"	NA	Green Isl
8	0.451	PWS_B8_BEACHWALKS_TX08	W147º 26´ 15.33"	N60º 16´ 36.37"	NA	Green Isl
9	2.648	PWS_B8_BEACHWALKS_TX09	W147º 30´ 39.04"	N60º 12´ 19.51"	NA	Green Isl
10	22.266	PWS_B8_BEACHWALKS_TX10	W147º 49´ 44.24"	N60º 04´ 09.11"	Start	Latouche Isl
10	22.266	PWS_B8_BEACHWALKS_TX10	W148º 01´ 42.24"	N59º 58´ 38.19"	End	Latouche Isl
11	2.401	PWS_B8_BEACHWALKS_TX11	W147º 59´ 40.54"	N60º 03´ 57.01"	Start	Sawmill Bay
11	2.401	PWS_B8_BEACHWALKS_TX11	W148º 00´ 15.15"	N60º 04´ 11.92"	End	Sawmill Bay
12	0.800	PWS_B8_BEACHWALKS_TX12	W148º 03´ 05.68"	N60º 03´ 28.55"	Start	Sawmill Bay
12	0.800	PWS_B8_BEACHWALKS_TX12	W148º 03´ 34.76"	N60º 03´ 17.18"	End	Sawmill Bay
13	3.201	PWS_B8_BEACHWALKS_TX13	W148º 04´ 00.18"	N60º 03´ 08.77"	Start	Sawmill Bay
13	3.201	PWS_B8_BEACHWALKS_TX13	W148º 02´ 35.6"	N60º 02´ 53.05"	End	Sawmill Bay
14	0.800	PWS_B8_BEACHWALKS_TX14	W148º 02´ 15.95"	N60º 02´ 56.73"	Start	Sawmill Bay
14	0.800	PWS_B8_BEACHWALKS_TX14	W148º 02´ 05.62"	N60º 02´ 56.05"	End	Sawmill Bay
15	0.560	PWS_B8_BEACHWALKS_TX15	W148º 00´ 05.59"	N60º 02´ 18.05"	Start	Elrington Isl
15	0.560	PWS_B8_BEACHWALKS_TX15	W147º 59´ 45.68"	N60º 02´ 07.14"	End	Elrington Isl
16	1.203	PWS_B8_BEACHWALKS_TX16	W148º 10´ 36.39"	N59º 58´ 37.8"	Start	Elrington Isl
16	1.203	PWS_B8_BEACHWALKS_TX16	W148º 10´ 39.2"	N59º 58´ 08.46"	End	Elrington Isl
17	1.051	PWS_B8_BEACHWALKS_TX17	W148º 04´ 56.39"	N59º 55´ 37.93"	Start	Danger Isl
17	1.051	PWS_B8_BEACHWALKS_TX17	W148º 04´ 27.97"	N59º 55´ 31.88"	End	Danger Isl

Table 2. Alaska Peninsula intensive block 10 beachwalks transects 1-6 start and end points with latitude and longitude in NAD 83 zone 5

TRANSECT	LENGTH_KM	TRANSECT_NAME	LON_DMS	LAT_DMS	START / END
1	32.722	AP_B10_BEACHWALKS_TX01	W153° 18´ 55.72"	N58°50´29.51"	Start
1	32.722	AP_B10_BEACHWALKS_TX01	W153°27´15.99"	N58°42´27.04"	End
2	10.855	AP_B10_BEACHWALKS_TX02	W153°49´53."	N58°36´39."	Start
2	10.855	AP_B10_BEACHWALKS_TX02	W153°53´08.47"	N58°34´37."	End
3	7.792	AP_B10_BEACHWALKS_TX03	W153°52´31.33"	N58°34´10.55"	Start
3	7.792	AP_B10_BEACHWALKS_TX03	W153°55´26.79"	N58°31´06.64"	End
4	38.560	AP_B10_BEACHWALKS_TX04	W153°59´11.78"	N58°29´18.85"	Start
4	38.560	AP_B10_BEACHWALKS_TX04	W153°59´01.5"	N58°23´30.35"	End
5	15.120	AP_B10_BEACHWALKS_TX05	W154°02´42.62"	N58°21´22.86"	Start
5	15.120	AP_B10_BEACHWALKS_TX05	W154°11´56.99"	N58°21´14.62"	End
6	8.266	AP_B10_BEACHWALKS_TX06	W154°09´03.75"	N58°18´56.34"	Start
6	8.266	AP_B10_BEACHWALKS_TX06	W154°06´11.89"	N58°16´43.61"	End

3.3 Field Season Preparation

Prior to each field season, local coordinators should review coastline surveys standard operation procedures along with the master field schedule (see N-REM sampling protocol table 10) and a prepared list of tasks to be performed and set field schedule. Local coordinators will determine segments to be walked, select dates, assign crews to segments, and train new crew members as needed (see training below), arrange for all logistics (e.g. vessel charter if needed), and obtain any necessary permits. Coordinators are also responsible for gathering needed equipment and supplies. An equipment and supply list is as follows:

-Latex, vinyl, or nitryl gloves (several pairs per person)
-Ruler (one per person)
-Keys and guides to animals (one set)
-Knife (one per person for removing sea otter skulls from carcasses and cleaning skulls)
-GPS (optional but preferred. one per crew of two persons or more)
-Map of segments to be walked with locations and photos of man-made structures, large debris items, sites of human activity, and keeper beaches attached (one per crew of two persons or more)
-Digital camera (one per two persons or more)
-1 quart plastic bags (closable freezer bags for animal carcasses and skulls, five per crew member per day).
-Permanent markers (two per person)
-Pencils (several per person)
-Field notebook (waterproof paper type – one per person)
-Field data sheets or checklists (one per person per segment)
-Binoculars (one per person)
-Standard operating procedures
-Safety equipment
-Permits

3.4 Sequence of Events

Coastline surveys of birds and mammals, animal carcasses, debris, and other resources will be conducted on an annual basis within selected areas of the Nearshore Restoration and Ecosystem Monitoring (N-REM) regions (Prince William Sound (PWS), Kenai Peninsula (KP), Kodiak archipelago (KOD) and Alaska Peninsula (AP) (see N-REM sampling protocol). Surveys are to be conducted during late April or early May, after snow melt but prior to summer re-vegetation. This survey time should coincide with the event of spawning by herring (mid to late April).

3.4.1 Sequence of events in the field

Crews of two or more are to locate the segment to be walked and walk beaches and record data as follows:

- Identify and count live birds and mammals (Tier II and III only)
- Identify and count marine mammal, bird, and invertebrate carcasses
- Identify and record locations of man-made structures, large debris, and sites of human activity
- Collect sea otter skulls as found

- Count sea otter or sea star pits
- Identify prey in sea otter spraint (Tier III only)
- Describe the relative abundance of plants in beach wrack (Tier II and III only)
- Collect small debris from keeper beaches as they occur along the segment
- Record data on geomorphologic changes
- Record locations of herring spawn

3.4.2 Details of Data Collection - Live Birds and Mammals (Tiers II and III only)

Species of birds and mammals that are closely associated with the shoreline are to be counted and recorded as the total number observed along each segment. The data will be used to track large-scale changes in the distribution of nearshore vertebrates. Species to be counted include black oystercatchers, harlequin ducks, goldeneye ducks (both barrows and common), bufflehead ducks, mergansers (common and red- breasted), scoters (white-winged, black, and surf), bald eagles (nests only), sea otters, harbor seals, sea lions, river/land otters, and mink. Care should be taken not to double count "roll ups" or birds and mammals that are flushed and then move ahead of the observer. In addition, the number of domesticated animals and land mammals that frequent the coastline, including bears, deer, moose, coyote, dogs, cats, cattle, and horses should be counted. If the number per group of individuals for a given species observed at a particular location along the shore exceeds one hundred, record the number as greater than one hundred (>100). Approximate locations for oyster catchers and eagles nests should be noted using a GPS or by placing positions on a map. Species are to be identified using commonly available guides (e.g. O'Clair and O'Clair 1998, Sibley 2000). Binoculars should be used to aid in identifying bird species.

A checklist of other species of birds or mammals observed should be made for each segment. These should include, but should not be limited to: harbor porpoises, beluga whales, humpback whales, minke whales, gray whales, mallards and other ducks, and shorebirds. A separate checklist should be made to include a checklist for types of animal tracks or scat observed on a given segment.

3.4.3 Details of Data Collection – Birds and Mammal Carcasses

Carcasses of marine mammals and birds are to be counted to indicate possible die-offs of these animals, potential sources of mortality, and changes in large-scale distribution patterns. Animals are to be identified to the lowest possible taxon and the number of each taxon observed per segment recorded. Procedures for identifying dead birds may be quite different from those used to identify live animals. Often it is best to start with the foot key (Appendix B) to narrow down the bird to family. Identification manuals that may be helpful in identification include Ainley et al. (2003) and Sibley (2000). Photographs of sea otter carcasses and skulls are given in Figures 2 through 4). If organisms can not be identified to species, then record the taxon as unidentified and, if possible, photograph the specimen using a digital camera. The photograph should be given a date/time stamp and the photo number logged on the datasheet or in a field notebook. Lay a yellow plastic ruler next to the bird for scale. Wearing gloves (latex, vinly, or nitryl), remove any debris from the animal and spread out limbs/wings. Pose the animal and rest the head in a side-on profile position. Photograph both dorsal and ventral views.

The condition of each dead organism is to be noted and classified as follows: fresh (edible without a putrid odor and no evident decomposition), moderately decomposed (days to weeks old), advanced decomposition (weeks to months old, with skeletal remains and some flesh remaining), skeletal remains only (no soft tissues, but bones not yellowed or moss covered), old skeletal remains, likely from carcass deposition from previous years (i.e. bones yellowed or moss covered). The cause of death will rarely be discernable, but should be noted when possible. The categories for cause of death include being shot (as evidence by a gunshot wound), wrapped in fishing line, wrapped in plastic debris, oiled, or unknown.

If oiled birds or mammals are noted, or there is direct evidence of a spill of oil or other toxic substances, contact the US Coast Guard or the National Response Center (1-800-424-8802). If fresh marine mammal carcasses are observed, a position of the carcass should be obtained and representatives from appropriate state and federal management agencies should be notified for additional collections and pathology work. If fresh sea otter carcass are found, please contact U.S. Fish & Wildlife Service, the Marine Mammals Management office (1-800-362-5148), or Alaska SeaLife Center, (1-888-774-7325). Fresh marine mammal carcasses (i.e. whale, seal, or sea lion) should be reported to National Marine Fisheries Service (1-800-853-1964).

If a TIER III crew person qualified and permitted to conduct sea otter necropsies is available, fresh sea otter carcasses are to be collected and necropsied as soon as possible, and tissue samples are to be collected for potential toxicology and histopathology studies (see Standard Operating Procedures for Collection and Archival of Marine Mammal Tissue, follow protocol http://www.absc.usgs.gov/research/ammtap/methods.htm). Also, the baculum should be collected if present and the length noted on the data sheet. The age class, sex, and diameter of the canine tooth collected (if any) should also be noted. Age class and sex will be able to be determined only for carcasses that are relatively intact. These are to be determined using the following guidelines:

- Pup, 0-1 years old Length < 100 cm, skull sutures not fused, deciduous teeth may be present
- Juvenile, 1-2 years old Skull not fused, permanent teeth with little wear
- Adult, 2-8 years old Length 109-145 cm, skull suture fused, sagital crest prominent, adult dentition with tooth wear moderate to extreme, surface of skull smooth and glossy
- Aged Adult, > 9 years old Skull suture fused, tooth wear may be extreme, worn and pitted

Sexes are to be recorded as male, female, or undetermined. Guidelines used for determining sex are as follows:

Male: Baculum or testicles present
Female: Fetus or pup, mammae or female reproductive tract present
Undetermined: Above features not present or unable to be determined.

Figure 4. Sea otter skeletal remains on beach.

Figure 5. Adult sea otter skull dorsal view.

Figure 6. Adult sea otter skull frontal view.

3.4.4 Sea otter skulls

Skulls of sea otters are to be collected to provide data on age-at-death and to provide data for demographic models that examine changes in the age distribution of dead otters. Sea otter skulls should be taken from all carcasses and placed in a sample bag (1 quart closable freezer bag). Remember to wear latex, vinyl, or nitryl gloves when handling skulls. For fresh carcasses, it may be necessary to remove the skull from the attached skin or skeleton using a knife. Attempt to remove all skin or other soft tissue from the skull. Label the bag (using a waterproof marker) with the date of collection, collector, region of collection (i.e. Prince William Sound, Kenai, Alaska Peninsula, or Kodiak), and segment number. After each collection day, the bags containing skulls collected on that day should be numbered sequentially. Numbers should be sequential for all skulls collected in a region in a given year if possible. All skulls are to be immediately returned to the regional coordinator if possible, or shipped directly to:

James L. Bodkin
U.S. Geological Survey
Alaska Science Center – Biological Resources Division
1011 E. Tudor Rd.
Anchorage, AK 99503

The skulls should be wrapped in protective material (like bubble wrap), double bagged (using a plastic trash bag or larger closable bag), and placed in a sturdy cardboard box for shipping. If skulls have fresh tissue attached, it may be necessary to ship the skull in a container with ice. The box should contain a shipping label that indicates who shipped the material, a return address (for purposes of postage reimbursement), the dates of collection, and region in which skulls were collected.

NOTE - It is unlawful to possess the bones or other body parts of sea otters, or endangered threaten species without appropriate permits. Regional coordinators should obtain appropriate permits prior to collection and shipment of sea otter skulls.

Once in the USGS laboratory, the skulls will be cleaned and catalogued, and teeth will be extracted and shipped for subsequent aging.

3.4.5 Sea otter or sea star pits

Surveys of pits dug by sea stars (especially Pycnopodia helianthoides) and sea otters are to be used to document foraging sites and potential changes in foraging behavior of sea stars and sea otters. Note the location and approximate number (10 to 100, greater than 100) of locations where 10 or more sea otter or sea star pits are observed per 50 linear m of shoreline. The pits are generally rounded or oval in shape, approximately 0.5 m wide and about half as deep as wide (Figure 5). They are generally observed below the high tide line on gravel, sand, or mud shorelines. The position of the approximate center area where pits are observed should be recorded. Latitude and longitude (decimal degrees, WGS84 or NAD83 datum) should be recorded using a GPS or the position should be noted on a map.

Figure 7. Pits dug by sea otters in the intertidal zone.

3.4.6 Sea otter spraint (TIER III only)

Sea otter spraint (scat) is to be examined to determine the relative proportion of prey items in the spraint and to provide supplemental information of the diet of sea otters. Changes in diet may indicate changes in the relative availability of prey. Spraint is generally found above the high tide line in areas where sea otters haul out, especially during winter (see Figure 8). Relatively large numbers of scat (more than ten within a 50-m segment of shoreline) are generally observed at haul out sites. Observers should record the relative abundance of various prey items within ten haphazardly selected spraint per site. Only spraint that is relatively fresh (with some organic material still present) should be examined. Prey categories to be recorded include clams, mussels, sea urchins, and other. Observers should note the predominant prey item as well as the presence and approximate proportion of any other identifiable prey.

Figure 8. Typical sea otter spraint in the high intertidal zone containing clam and mussel shell material.

3.4.7 Beach-stranded invertebrates

Surveys of beach-stranded invertebrates are to be used to document large-scale die offs of animals and to examine potential changes in the distribution of invertebrates. f mass stranding (more than 5 within a 100 m section of beach) of invertebrate animals (e.g. sea stars, crabs, sea urchins, jellyfish) are noted, count all dead organisms. If there are more than 100, estimate the number to the nearest 100. Invertebrates counted should be restricted to animals larger than 5 cm (about 2 inches or larger than a silver dollar). This would exclude clam and mussel shells, small crustaceans, etc. Note the position of approximate center of distribution of carcasses. Mark the position on a map or record latitude and longitude from a GPS. Photograph as large a portion of the area where mass stranding has occurred as possible. If organisms can not be identified to species, then photograph or collect at least 3 representative specimens for later identification. Invertebrate species are to be identified using standard references (e.g. O'Clair and O'Clair 1998).

3.4.8 Algae and seagrasses in beach wrack (TIERS II and III only)

Algae and seagrasses that are deposited on the beach form a wrack or line of drift at the storm tide and high tide lines. The relative abundance of algal and seagrass species within the wrack may indicate changes in species distribution and abundance. For example, andecdotal observations over the past decade indicate an increase in the amount of giant kelp (Macrocystis pyrifera) found on beaches, indicating a northerly shift in the distribution of this speices that has heretofore rarely been observed north of Southeast Alaska. Observers are to determine the relative abundance of algal and seagrass species within the wrack for each segment. The algae and seagrass are to be classified and recorded as rockweed (Fucus gardneri), bull kelp (Nereocystis luetkeana), giant kelp (Macrocystis pyrifera, small brown kelps (e.g. Agarum clathratum, Costaria costata, Cymathere triplicata, Desmarestia spp., Laminaria spp., and other smaller brown bladed kelps), dragon kelp (Alaria fistulosa), eelgrass (Zostera marina), and red or green algae. Species are described in O'Calir and Lindstrom (2001). The relative abundance of each algal or seagrass type is to be determined as the percent by volume found on each beach segment and is to be categorized as greater than 75%, 1 to 75%, present but less than 1%, or absent.

Figure 9. Beach wrack consisting of giant kelp (Macrocystis pyrifera) found in Western Prince William Sound in 2005.

3.4.9 Man-made structures, large debris items, and areas of human disturbance
Documenting the number and location of large man-made structures, debris, and human activities is to be used to assist in detecting changes in patterns of human-use along the shoreline that may impact nearshore animal and plant communities. Observers should briefly describe and

note the location of large man-made structures (buildings, docks, rip-rap and other erosion control structures, pipelines, outfalls), large debris items (any item larger than about 2m x 2m including wrecked boats, aircraft, refrigerators, autos or other vehicles, etc.), and areas of intense human activity (garbage or refuse dumps, camps, coaling sites, horseback riding areas, areas for harvesting of clams or other marine resources, and archeological sites). Latitude and longitude (decimal degrees, WGS84 or NAD83 datum) should be recorded using a GPS or the position noted on a map. Structures and large debris items should be photographed with a digital camera if possible. After these items are documented in an initial survey of each segment, the continued existence of previously found items should be noted and position and type of any new items recorded.

3.4.10 Smaller debris items on keeper beaches

Monitoring of the amount and relative proportion of different types of smaller debris is to be used to document changes in patterns of human use along shorelines. Observers will collect, categorize, and estimate the abundance of smaller debris items (plastic bottles, beverage containers, buoys, nets, line, and other fishing gear, etc.) from shoreline segments. It would be too time consuming to quantify the occurrence of all smaller debris items on most segments. Therefore, the occurrence of smaller debris items is to be documented only on selected portions of shoreline segments called keeper beaches, sites where debris tends to accumulate. In initial surveys, keeper beaches (approximately 50- to 100-m sections of shoreline with relatively large amounts of debris) will be identified. The goal is to select 10 keeper beaches per region (Prince William Sound, Kenai Peninsula, Alaska Peninsula, and Kodiak) that are relatively evenly distributed within area to be sampled in each region. If more than 10 keeper beaches per region are identified, then 10 shall be selected for annual sampling that provide a relatively uniform spatial distribution within the region. Selection will also be based on the accessibility of the site, the amount debris noted, and the ease at which debris can be quantified at that site. At each site, observers will take digital photos of the site and note the position from which the photo was taken so that the same photo can be duplicated in subsequent years. If possible, take the photos from up and down beach of the site. Photos are to be time and date stamped and later identified by site number and position within the site. All debris that can be removed from the site will be collected and sorted by type. Often, items are buried into the sediment and can not be removed. These buried items should be left in place unless they can be removed by hand (without the aid of a shovel or other tool). The types of debris will be classified as fishing and boating gear (line, nets, buoys, pieces from small boats, rubber rafts, etc.), plastic containers for liquids (water bottles, plastic jugs, etc.), miscellaneous plastic materials (tarps, plastic sheeting, garbage bags, food containers, etc.), glass bottles and other glass containers for liquids (soda bottles etc.), and metal containers (propane bottles, soda cans, gasoline or other fuel containers, etc.). Note the number of 33 gallon trash bags (in increments of one-half bags) filled with each debris type. Do not crush cans or other materials. Note the latitude and longitude (decimal degrees, WGS84 or NAD83 datum) for boundaries of each keeper beach using a GPS.

3.4.11 Novel floatable debris

Observers will document the number and type of all novel drifting debris on each segment that may be used to track ocean currents. These should include rubber bath toys, hockey gloves, Nike shoes, logs with plastic tags, plastic Japanese survey stakes, and any other novel items that might have recently been spilled from cargo vessels. Updates on items of particular interest should be obtained just prior to the survey from the Beachcombers' Alert newsletter (available from

Beachcombers an Oceanographers International Association, c/o Dr. Curtis Ebbesmeyer, 6306 21st Ave. NE., Seattle WA. 98115-6916). Report the number, type, and approximate location (latitude and longitude of the segment boundaries) of all items collected reported to Dr. Ebbesmeyer at the above address, or by email at curtisebbesmeyer@msn.com.

3.4.12 Herring spawn

Herring spawn is an important food source for a number of nearshore birds and animals in the GOA. Surveys of spawning areas are to be used to document changes in the distribution and relative abundance of spawn over time. The start and ending positions of locations along the shoreline where herring spawn is observed should be recorded. Spawning sites are to be noted either by recording positions obtained from a GPS, or by recording positions on a map and later determining positions using a GIS. Herring spawn can be identified as opalescent egg masses attached to algae, sea grasses, rocky substrata, or debris (Fig. 10).

Figure 10. Herring spawn on an intertidal beach. (Photo compliments of E. Brown)

The relative abundance should be classified with respect to both average percent cover and average thickness of egg masses and recorded as follows:

Relative Cover
Heavy - greater than 75% of substrate covered
Moderate - 25% to 75% of substrate covered
Light - less than 25% of substrate covered

Relative thickness
Heavy - greater than 2 cm average depth

Moderate - 0.5 cm to 2 cm average depth
Light - less than 0.5 cm average depth

Also note the predominant substrate type to which spawn is attached. These are to be classified as rockweed (Fucus gardneri), other brown seaweed, green or red seaweed, seagrass, rock, debris or man-made structures. Also note any animals noted feeding on the spawn.

3.4.13 Changes in geomorphology
Major geomorphologic changes to the shoreline that have occurred over the past year will be noted. These are to include, for example: large slide areas, areas where beaches have eroded, or sites where marine sediments have accumulated. A position of the site where changes have occurred will be noted. Positions (latitude and longitude, decimal degrees, NAD 83 or WGS 84 datum) will be determined using GPS or locations will be noted on a map and coordinates determined later using GIS. The type of change will be noted. Changes will be classified as follows: eroded by waves or currents, eroded by glacial action, slide or cliff failure, glacial sediment deposition, stream sediment deposition, marine sediment deposition, uplift due to earthquake, subsidence due to earthquake. The extent of the change will be described in terms of the linear extent (meters) of shoreline affected and the average horizontal extent (shift in the position of the high tide line in meters).

3.5 Post-survey procedures
At the completion of each survey day, observers are to go over field notes and make a list of any unusual or general observations not encompassed in the survey data. Waypoints for GPS units are to be downloaded into a computer file. Descriptions of each waypoint and reference to any photos taken are to be made in the file. Digital photos are also to be downloaded to a computer file and a short description of the photo (including a date-time stamp and latitude longitude or segment number) is to be made in the file. Specimens of unidentified plants or animals are to be identified or (preserved for later identification if a positive identification can not be made) and the data annotated accordingly.

Sea otter skulls collected are to be appropriately labeled (see page 17) and prepared for shipment (refer to protocol according to Matson Laboratories at:http://www.matsonslab.com/index.htm).

The teeth are to be sent to address below for determination of age-at –death:

Matson Laboratories Matson's Laboratory LLC
US Post Office address:
PO Box 308, Milltown MT 59851 USA
Physical address (for UPS, FedEx, and other couriers):
8140 Flagler Road, Milltown MT 59851 USA
Email address: gjmatson@montana.com

Laboratory procedures for aging teeth are given in Bodkin et al 1997.

All data sheets, data notebooks, and field notes are to be reviewed for accuracy and legibility and transcribed if necessary. All data and specimens collected are to be to given to the regional coordinator ore a specified representative. Appropriate authorities are to be notified regarding observations of oil or other toxic substances, fresh marine mammal carcasses, or any illegal activities observed.

At the completion each field trip, coordinators are responsible for entering all data into computer files and reviewing any unresolved issues regarding the data with field crews.

Examples of field data sheets are in Appendix D. Data should either be entered onto paper data sheets and later entered into a computer file, or entered directly into the computer if a tablet PC is available.

3.6 End-of-season Procedures

At the end of each field season all equipment should be cleaned and serviced, and batteries removed for storage. Optics, tripods, and other equipment should be assessed for repair or replacement needs.

After each field season, the following are to be done:

- Clean and check all mechanical, optical, and electronic equipment and field gear for needed repair and store appropriately.
- Make repairs or obtain replacements for damaged or lost equipment or supplies.
- Produce a field season summary report based on daily and cruise reports.

4 Data Handling, Analysis and Reporting

4.1 Metadata Procedures

See N-REM Sampling Protocol Section 4.0.
The specific objectives of these shoreline surveys are:

- Document large-scale changes in abundance and distribution of bird and mammal species closely associated with the shoreline.
- Identify possible invasive species and regional shifts in species distributions by documenting the occurrence and or disappearance of plant and animal species in the local flora and fauna.
- Document anomalous large-scale die offs of birds, mammals, and invertebrates and suggest possible causes for die offs.
- Describe temporal and spatial patterns in survival rates of sea otters using estimates of age-at-death based on collections of beach-cast sea otter carcasses.
- Document changes in patterns of human-use based on direct observation of use and on surveys of the amount and type of debris on beaches.
- Identify temporal and spatial changes in herring spawning success by documenting the location and extent of herring spawn on beaches.
- Assist in development of models of ocean currents by documenting the time and location of discovery of materials spilled from cargo ships.
- Document large-scale changes in beach geomorphology (e.g. erosion of shorelines, landslides, or shifts in elevation due to earthquakes) that may impact nearshore marine.

4.2 Overview of Database Design

See N-REM Sampling Protocol Section 4.0.

4.2.1 Procedures for database design

A database design is currently under development for this procedure. In general, the design consists of a relational database consisting of a series of data entry forms, observation data tables, and a series of lookup tables describing the fields used in observational database. Currently, the databases are in Microsoft Access format. Separate databases are to be developed for metrics associated with a particular task (e.g. all data associated with sea otter carcass collections).

Lookup tables describe various fields used in the database and contain codes used to describe various fields. For example, the personnel lookup table contains the names of field crew members responsible for collection of sea otter skulls and their associated codes. Observation databases contain all information for a particular task. For example, the sea otter carcass observation file contains all information on sea otter carcasses that are collected.

4.3 Data Entry, Verification and Editing

See N-REM Sampling Protocol Section 4.0.
Data currently is entered from field datasheets into Microsoft Excel. Data is entered as soon as possible upon returning from the field. Raw data files are backed-up and the project manager

verifies that data within the .Excel spreadsheets matches the hardcopy recorded by the observer. The project manager edits data to correct discrepancies.

4.4 Routine Data Summaries and Statistical Analyses

The overall analytical approach is described in the N-REM plan/ (or sampling protocol section 4.0) that relies on data collected from most sampling protocols. In preparation of providing data derived from these surveys annual summaries should be completed by the regional coordinators.

Routine data summaries are to be generated for each region in each year. These are summarized for each of the various metrics generated as follows:

Counts of live birds and mammals – Plot the total number of birds and mammals by species for each region by year. (Plot only data for those segments observed in every year). Provide a checklist of species observed in each region in each year.
Mammal and bird carcasses - Plot the total number of bird and mammal carcasses by species for each region by year. (Plot only data for those segments observed in every year). Provide a checklist of species observed in each region in each year.

Sea otter skulls – Update tables indicating the age at death for sea otters carcasses collected within each region in each year.

Sea otter and sea star pits – Update GIS databases indicating the location where large numbers of pits were observed.

Sea otter spraint – Plot the relative proportion of predominant prey types within each region in each year. Plot the proportion of spraint in which each prey type was observed in each region in each year.

Beach stranded invertebrates – List mass strandings observed by species and region.

Algal beach wrack – Plot the mean relative proportion of each algal or seagrass species within each region over time.

Large debris – Update GIS databases and produce maps with locations of large debris items by type within each region. Flag items newly observed or removed since the prior year's survey.

Small debris on keeper beaches – Plot the volume of debris removed from each region by type in each year.

Novel debris – Update tables indicating the type and location of any novel debris items observed in each year and region.

Herring spawn – Update tables with the location of herring spawning sites observed in each year.

Changes in geomorphology – Update GIS databases and map the location of any changes in geomorphology observed.

Results, in the form of updated tables and figures and a summary of findings, are to be presented in annual reports. Long-term statistical analyses are to be presented in comprehensive reports presented every five years.

4.5 Report Format

Reports will conform to specific guidelines set by the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/NRPM/index.cfm). Reports will include maps, graphs, figures and other visuals to facilitate comprehension of findings.

4.6 Methods for Trend Analyses

Long-term trend analyses, as outlined in the protocol (Protocol section 4.2.1), are to be conducted to examine trends over time within each region, differences between regions, and interactions between time and region. Metrics to be examined include those listed in 4.2 above. In addition, survival data for sea otters, based on age at death as determined from teeth recovered from beach cast carcasses, are to be examined using modeling procedures as described in Monson et al. 2000. The survival models are to be used to identify any anomalous trends in survival (e.g. abnormally low survival among prime-age sea otters), provide evidence as to possible causes for observed trends in population abundance, and provide predictions with respect to future population abundance (e.g. Bodkin et al. 2002, Udevitz and Ballachey, 1993) In addition, data that may not be amenable to statistical analyses (e.g. observations of mass strandings of a particular species or the appearance of a potentially invasive species) should be reported and their potential significance discussed.

4.7 Data Archival Procedures

Refer to the SWAN Protocol Narrative for Marine Nearshore Ecosystem Monitoring (Dean and Bodkin 2009 Draft).

4.8 Reporting

Refer to the SWAN Protocol Narrative for Marine Nearshore Ecosystem Monitoring (Dean and Bodkin 2009 Draft).

5 Personnel Requirements and Training

5.1 Roles and Responsibilities

The survey work is to be conducted by professional marine ecologists, trained volunteer naturalists, and in some cases, relatively untrained volunteers such as youth groups. As a result, the protocols described here are broken into three tiers. Tier I describes survey methodologies that can be used by all surveyors after a brief (one day) training session that outlines safety procedures and data collection methods. Tier II describes tasks that can be done either by scientists or by more highly trained or experienced volunteers. It is anticipated that a training session of several days and or demonstration of proficiency with respect to identification of birds, marine mammals, selected marine invertebrates, and selected marine plants will be required in order to conduct Tier II surveys. Tier III tasks are to be conducted only by highly trained permitted scientists with specific training on, for example, necropsy methods for marine mammals. Each annual survey in each region is to be coordinated by a person familiar with the protocol and with data collection and entry methods. All personnel must be current with applicable safety training.

6 Operational Requirements and Workloads

6.1 Operational Requirements

A minimum of six crew members are required to conduct surveys in each region. The crews will be headed by regional coordinators or other N-REM staff. Other crew members may be permanent N-REM staff, seasonal employees, or volunteers.

6.2 Annual Workload and Field Schedule

Field surveys are to be conducted annually in the spring of each year. It is anticipated that, at a minimum, each region will be surveyed by a team of six persons over a period of four to six field days. Additional surveys may be conducted by volunteer groups. Approximately 0.5 months time will be required of each regional coordinator for filed preparation, coordination, and data entry. Approximately one month per year will be required for each of three N-REM staff (principal investigator, data analyst, and technician) in order to prepare for the filed season, prepare specimens collected for analysis, conduct analyses, and report the results.

6.3 Facility and Equipment Needs

Depending on the accessibility of beaches within a region, a vessel charter may be required to house survey crews. This vessel should accommodate at least six field crew members and be equipped with skiffs for accessing the beach. It is anticipated that, at a minimum, vessel charters will be required for Prince William Sound and Alaska Peninsula regions.

A digital camera is required for each pair of field crew. GPS units are also highly recommended (one per pair of crew members).

6.4 Start-up Costs and Budget Considerations

Startup costs include the purchase of a minimum of three digital cameras and (preferably) three GPS units per region. Other start up costs includes the completion of the database structure. The annual budget is estimated at $27,000 per each region. This cost assumes that each region will be surveyed using N-REM or NPS staff. These costs may be lowered if volunteers are used to conduct field surveys.

7 Procedures for Revising the Protocol

All edits and amendments made to the protocol narrative and/or SOPs should be recorded in the revision history log table at the beginning of this document. Users of this protocol should promptly notify the project leader of the marine nearshore monitoring program of recommended edits or changes. The project leader will review and incorporate suggested changes as necessary, record these changes in the revision history log, and modify the date and version number on the title page of this document to reflect these changes.

It is anticipated that following at least three years of annual data collection it will be important to evaluate, in terms of power and sensitivity, the ability of the sampling design to detect change in the data derived from coastline survey data collection protocols. Following such analyses it may be appropriate to consider revising sampling design or data collection protocols.

8 Literature Cited

Ainley, D. G., G. W. Page, L. T. Jones, L. E. Stenzel, and R. L. LeValley. 1980. Beached marine birds and mammals of the North American West Coast: A manual for their census identification. *In* Report FWS/OBS-80/03 Beached marine birds and mammals of the North American West Coast: A manual for their census and identification. U.S. Fish and Wildlife Service, Biological Service Program, FWS/OBS-80/03.

Bodkin, J. L., B. E. Ballachey, T. A. Dean, A. K. Fukuyama, S. C. Jewett, L. McDonald, D. H. Monson, C. E. O'Clair, and G. R. VanBlaricom. 2002. Sea Otter Population Status and the Process of Recovery from the 1989 Exxon Valdez Oil Spill. Mar. Ecol. Prog. Ser. 241: 237-253.

Bodkin, J. L., J. A. Ames, R. J. Jameson, A. M. Johnson, and G. M. Matson. 1997. Estimating Age of Sea Otters with Cementum Layers in the First Premolar. J. Wild. Manage. 61(3): 967-973.

Bodkin, J. L. and R. J. Jameson. 1991. Patterns of Seabird and Marine Mammal Carcass Deposition along the Central California Coast, 1980-1986. Can. J. Zool. 69: 1149-1155.

Camphuysen, C. J. 1997. Oil pollution and oiled seabirds in the Netherlands, 1969-97: Signals of a cleaner sea. SULA 11(2): 43-156.

Camphuysen, C. J. and M. Heubeck. 2001. Marine oil pollution and beached bird surveys: the development of a sensitive monitoring instrument. Environmental Pollution 112(3): 443-461.

Center for Alaskan Coastal Studies. 2004. Gulf of Alaska CoastWatch Curriculum. Report for the Center for Alaskan Coastal Studies. pp 20

Dahlmann, G., D. Timm, C. Averbeck, C. J. Camphuysen, H. Skov and J. Durinck. 1994. Oiled seabirds: comparative investigations on oiled seabirds and oiled beaches in The Netherlands, Denmark and Germany (1990-93). Marine Pollution Bulletin 28(5): 305-310.

Monson, D. H., D. F. Doak, B. E. Ballachey, A. Johnson and J. L. Bodkin. 2000. Long-term impacts of the Exxon Valdez oil spill on sea otters, assessed through age-dependent mortality patterns. Proc. Natl. Acad. Sci. USA 97(12): 6562-6567.

O'Clair, R. M., and S. C. Lindstrom. 2000. North Pacific Seaweeds. Plant Press, Auke Bay, Alaska.

O'Clair, R. M. and C. E. O'Clair. 1998. Southeast Alaska's Rocky Shores: *Animals*. Plant Press, Auke Bay, Alaska.

Roletto, J., J. Mortenson, I. Harrald, J. Hall, and L. Grella. 2003. Beached bird surveys and chronic oil pollution in central California. Marine Ornithology 31: 21-28.

Sibley, D. A. 2000. The Sibley guide to birds. Alfred A. Knopf, Inc.

Udevitz, M. S. and B. E. Ballachey. 1998. Estimating survival rates with age-structure data. Journal of Wildlife Management 62(2): 779-792.

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9.0 Appendix

Appendix A Common names, scientific names, and codes for birds likely to be observed in the nearshore.

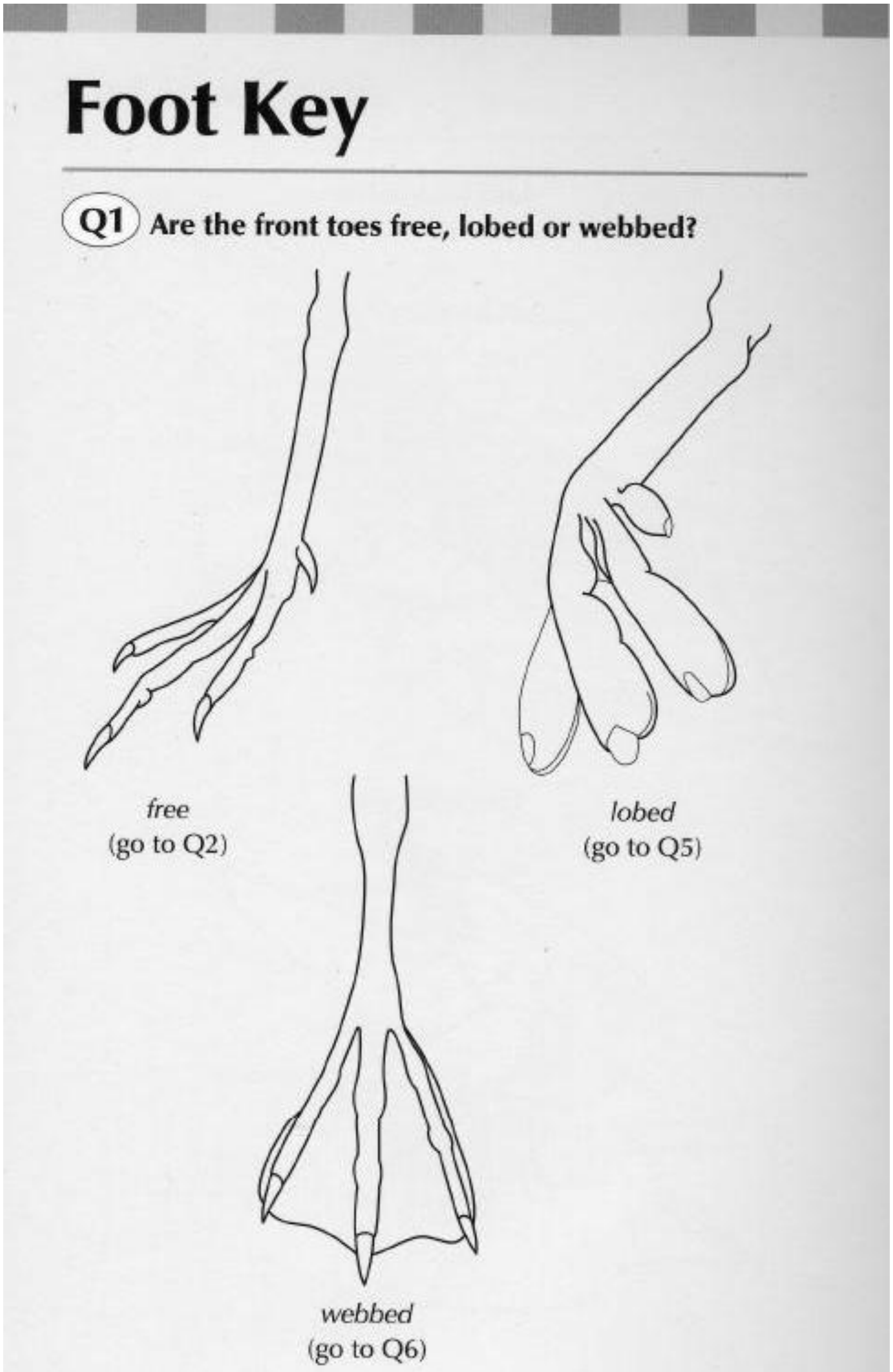
Common Name	Code	Scientific Name	Key Features
Ducks		**Anatidae**	Medium to large birds, Usually with pointed wings. Four toes, three webbed. Short legs. Bill with nail. Short tails. Larger paddle feet, Most patter along water before getting airborn, Rapid wingbeat
Barrow's goldeneye	BAGO	*Bucephala islandica*	
Black Scoter	BLSC	*Melanitta nigra*	
Bufflehead	BUFF	*Bucephala albeola*	
Common Goldeneye	COGO	*Bucephala clangula*	
Common Merganser	COME	*Mergus merganser*	
Red-breasted Merganser	RBME	*Mergus serrator*	
Greater Scaup	GRSC	*Aythya marila*	
Harlequin Duck	HADU	*Histrionicus histrionicus*	
Mallard	MALL	*Anas Platyrhynchos*	
Long-tailed duck	LTDU	*Clangula hyemalis*	
Unidentified Scoter spp.	USCO	*Melanitta spp*	
Unidentified Goldeneye spp	UNGO	*Bucephal spp.*	
Unidentified Merganser spp.	UNME	*Mergus spp.*	
Unknown Scaup spp.	UNSC	*Aythya spp.*	
White-winged Scoter	WWSC	*Melanitta fusca*	
Crows and Ravens		Corvidae	
Northwestern Crow	NOCR	*Corvus caurinus*	Length: 14.5 inches Entirely black plumage Squared-off tail Smaller than raven
Common Raven	CORA	*Corvus corax*	Large, Long narrow wings, long wedge-shaped tail, heavy bill

Common Name	Code	Scientific Name	Key Features
Cormorants		Phalacrocoracidae	Four webbed toes; expandable throat pouch. Bill strongly hooked at tip. Short legs at end of body
Double-crested Cormorant	DCCO	*Phalacrocorax auritus*	
Pelagic Cormorant	PECO	*Phalacrocorax pelagicus*	
Red-faced Cormorant	RFCO	*Phalacrocorax urile*	
Unidentified Cormorant	UNCO	*Phalacrocorax spp.*	
Eagle		Accipitridae	Mature White head neck and tail, Yellow bill and feet, Broad, straight-edged wings with relatively narrow “hands” Juvenile: Are a mixture of brown and white; with a black bill
Bald Eagle	BAEA	*Haliaeetus leucocephalus*	
Common Name	Code	Scientific Name	Key Features
Geese		Anserinae	Medium goose with medium gray breast, black neck and front of head, white cheek patches; male and female are marked the same, small-billed and short-necked, Black webbed feet
Canada Goose	CAGO	Branta canadensis	
Common Name	Code	Scientific Name	Key Features
Grebes		Podicipedidae	Medium birds, some small. Short, curved wings, tail very short. Feet set far back on body. 4 toes lobed. Sexes alike.
Red-necked Grebe	RNGR	*Podiceps grisegena*	
Horned Grebe	HOGR	*Podiceps auritus*	
Unidentified Grebe spp	UNGR	*Podiceps spp.*	

Common Name	Code	Scientific Name	Key Features
Gulls		Laridae	Black-legged Kittiwake: medium-sized gull, white head and body, slate-gray back and wings, black wingtips, and a yellow bill. The legs are black. Juvenile: has bold, black edgings on its wings and the nape Mew Gull: small sized gull. Similar body characteristics of BLKI except both the beak and legs are yellow
Black-legged kittiwake	BLKI	*Rissa tridactyla*	
Large Gull spp	LGGU	*Larus spp*	
Mew Gull	MEGU	*Larus canus*	
Unidentified Gull	UNGU	*Larus spp.*	
Heron		Ardeidae	Large, sturdy; heavy bill. large bird, with a slate-gray body, chestnut and black accents, and very long legs and neck. a six-foot wingspan. Adults sport a shaggy ruff at the base of their necks. A black eyebrow extends back to black plumes emerging from the head. Juveniles have a dark crown with no plumes or ruff, and a mottled neck
Great Blue Heron	GRBH	*Ardea herodias*	
Loons		Gavidae	Large birds. Long pointed bill, wings narrow, pointed. Tail short, stiff. Legs at end of body. 4 toes, 3 fully webbed. Species differ in bill size and angle of tilt. Sexes alike.
Common Loon	COLO	*Gavia immer*	
Pacific Loon	PALO	*Gavia pacifica*	
Red-throated Loon	RTLO	*Gavia stellata*	
Yellow-billed Loon	YBLO	*Gavia adamsii*	
Unidentified Loon	UNLO	*Gavia spp.*	
Murres		**Alcidae**	Small to medium birds, often with chunky bodies and short necks. Short, stubby wings and short legs set far back on
Common Murre	COMU	*Uria aalge*	

Common Name	Code	Scientific Name	Key Features
Thick-billed Murre	TBMU	*Uria lomvia*	body. Bill highly variable, some extremely colorful. Three front toes, no hind toes.
Unidentified Murre spp	UNMU	*Uria spp*	
Common Name	Code	Scientific Name	Key Features
Murrelets		**Alcidae**	Small to medium birds, often with chunky bodies and short necks. Short, stubby wings and short legs set far back on body. Bill highly variable, some extremely colorful. Three front toes, no hind toes.
Kittlitz's Murrelet	KIMU	*Brachyramphus brevirostri*	
Marbled Murrelet	MAMU	*Brachyramphus marmoratus*	
Brachyramphus Murrelet (unidentified)	BRMU	*Brachyramphus* Murrelet	
Pigeon Guillemot		*Cepphus columba.*	
Shorebirds		Haematopodidae	Large shorebird Bright orange, long, thick bill Plumage entirely black Pink legs Yellow eye Orange orbital ring Juvenile like adult but bill has dark tip and plumage is browner
Black Oystercatcher	BLOY	*Haematopus bachmani*	

Appendix B. Foot key for bird families (www.tufts.edu/vet/seanet/index.html)



Q2 If free, does the foot have 3 or 4 toes?

3

3-TOED SHOREBIRDS

STOP

4

(go to Q3)

Q3 If 4 toes, is the 4th nail strongly arched?

not strongly arched

(go to Q4)

strongly arched

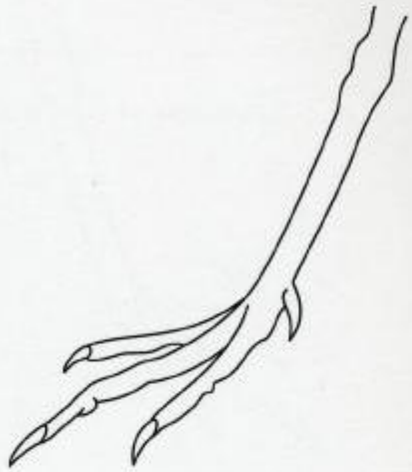
PERCHING BIRDS

STOP

Q4 **Are toes fleshy or not?**

fleshy
PIGEONS

STOP



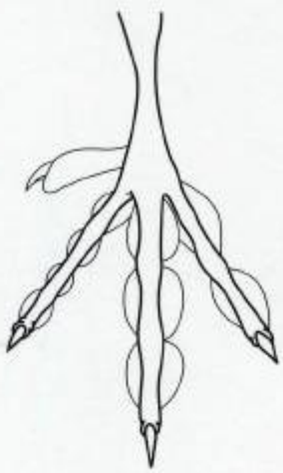
not
4-TOED SHOREBIRDS

STOP

Q5 **If lobed, are the lobes single or multiple?**

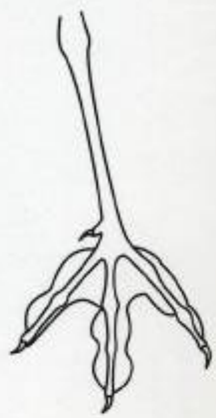
single
GREBES

STOP



multiple, large foot
COOTS

STOP



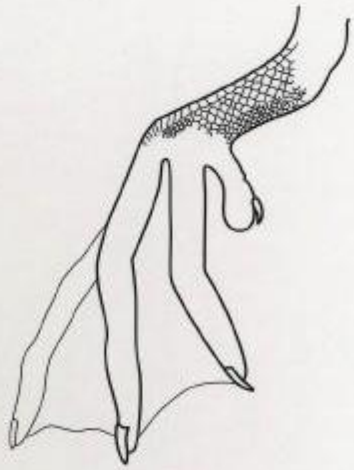
multiple, small foot
PHALAROPES

STOP

Q6 If front webbed, is the webbing partial or complete?

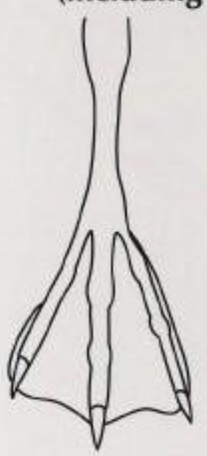
partial
PARTLY-WEBBED SHOREBIRDS

STOP



complete
(go to Q7)

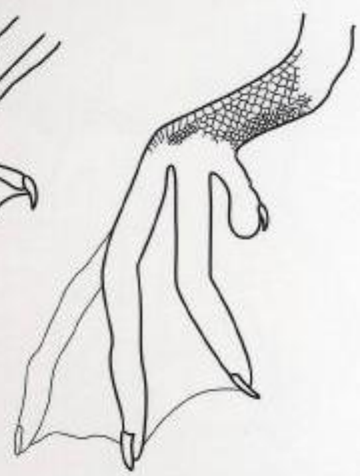
Q7 If completely webbed, does the foot have 3 or 4 toes (including minute 4th toe)?



3 webbed
(go to Q8)

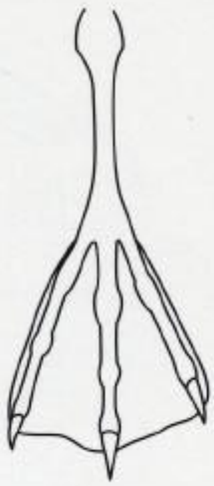
4 webbed
POUCHBILLS

STOP



4th toe smaller and free
(go to Q9)

Q8 **If 3 webbed toes, is the foot huge?**



yes

TUBENOSE: ALBATROSSES

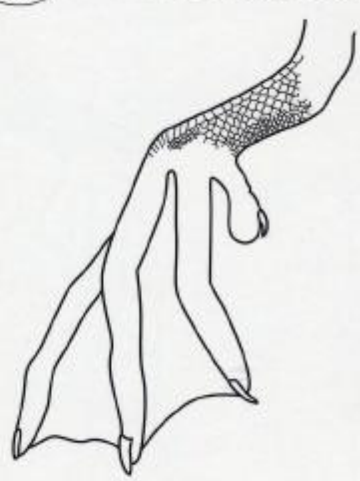
STOP

no

ALCIDS

STOP

Q9 **If 4th toe smaller and free, is it lobed?**



lobed

WATERFOWL: DIVERS

STOP

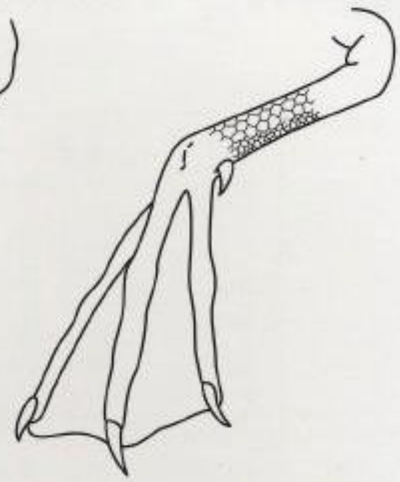
no

(go to Q10)

Q10 Is the 4th toe small or minute?

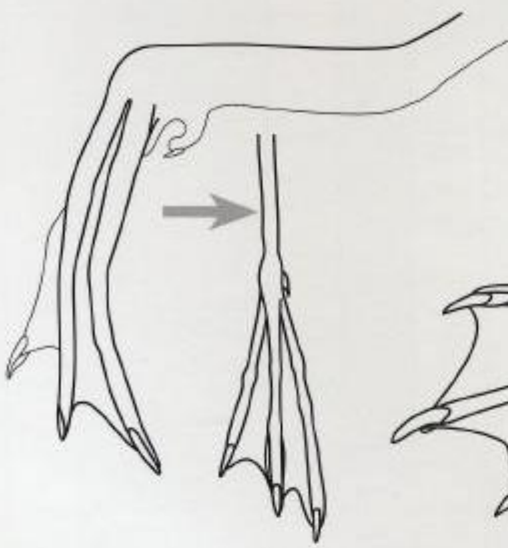
small
WATERFOWL: TIPPERS

STOP



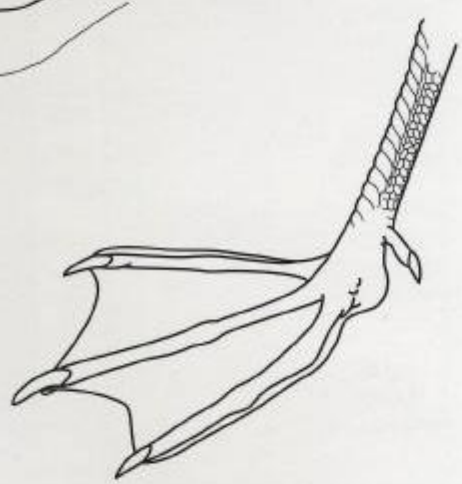
minute
TUBENOSE: PETRELS

STOP



minute, and extremely thin, flat tarsi
LOONS

STOP



minute, and swollen heel
LARIDS

STOP

Appendix C. GPS PDFs and information

A GPS will be used in coastline survey. The following PDFs and web page (http://www.garmin.com) contain information on purchasing GPS Map76S units, owner's manual, and instruction manual (see PDFs below).

GPSMAP76S_OwnersManual.pdf

GPSGuideforBeginners_Manual.pdf

GPSMAP76S_QuickStartGuide.pdf

Appendix D Data sheets and data dictionaries

Coastline Survey Data Sheet			
Observers: *Note – Provide address, phone number, and email if not on file			
Date:	Region:	Segment or Zone No.:	
Start Latitude Start Longitude:		End Latitude: End Longitude:	
Estimated proportion of segment walked:			
Live birds and mammals Counts of:			
Bufflehead:		Bears:	
Eagle: and/or nest:		Cats:	
Goldeneye		Cattle:	
Harlequin duck:		Coyote:	
Mergansers:		Deer:	
Oystercatcher: and/or nest:		Dogs	
Scoters:		Horses:	
		Mink:	

<table>
<tr><td colspan="2">Harbor seal:</td><td colspan="2">Moose:</td></tr>
<tr><td colspan="2">River otter:</td><td colspan="2">Other:</td></tr>
<tr><td colspan="2">Sea otter:</td><td colspan="2" rowspan="2">Comments:</td></tr>
<tr><td colspan="2">Steller sea lion:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Coordinates for oystercatchers nest:

*Position (lat/long, waypoint number, or recorded on map)</td></tr>
<tr><td colspan="4">Coordinates for eagles nest:

*Position (lat/long, waypoint number, or recorded on map)</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Checklist of other live birds or mammals observed:</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Checklist of mammal tracks or scat observed:</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

Condition Codes of Dead Organisms	
Description	Code
Fresh (edible without putrid odor and no evident decomposition)	FRSH
Moderately decomposed (days to weeks old)	MOD
Advanced decomposition (weeks to months old, with skeletal remains and some flesh remaining)	ADV
Skeletal remains only, (no soft tissues, but bones not yellowed or moss covered)	SKT
Old skeletal remains, likely from carcass deposition in a previous year (i.e. bodes yellowed or moss covered).	PYR
Cause of Death Codes of Organisms	
Description	Code
Shot	SHT
Fishing line wrapped	FLN
Plastic debris wrapped	PLS
Oiled	OIL
Other	OTH
Unknown	UNK

Contact Numbers:
Oiled Birds or Mammals – U.S. Coast Guard or National Response Center – 1-800-424-8802
Fresh Sea Otter Carcasses – U.S. Fish and Wildlife Service, Marine Mammals Management office – 1-800-362-5148 or Alaska SeaLife Center – 1-888-774-7325
Other Fresh Marine Mamma Carcasses (i.e. whales, seals, and sea lions) – National Marine Fisheries Service – 1-800-853-1964

Bird and Mammal Carcasses			
Observers: *Note – Provide address, phone number, and email if not on file			
Date:	Region:	Segment or Zone No.:	
Start Latitude Start Longitude:		End Latitude: End Longitude:	
Estimated proportion of segment walked:			
Taxon	Condition	Cause of Death	Photo No.

Sea otter and sea star pits

The pits are generally rounded or oval in shape, approximately 0.5 m wide and about half as deep as wide. They are generally observed below the high tide line on gravel, sand, or mud shorelines. The position (Lat/Long or waypoint) of the approximate center area where pits are observed should be recorded.

Observers:

*Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:

Number of pits *Number of pits = 10 to 100 or >100	Position *Position = lat/long, waypoint number, or recorded on map	Photo Number

Comments:		

Sea otter Spraint Spraint (scat) is generally found above the high tide line in areas where sea otters haul out, especially during winter. Only spraint that is relatively fresh (with some organic material still present) should be examined
Observers: *Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:

Position (lat/long, waypoint number, or recorded on map):
Prey types = Clams, mussels, sea urchin, other (describe) Observers should record the relative abundance of various prey items.

Scat No.	Predominate prey	Other Prey (describe)	Position
1			
2			
3			
4			
5			
6			
7			
8			
9			

10			
11			
12			
13			
14			
15			
Comments:			

Beached Invertebrates If mass stranding (more than 5 within a 100 m section of beach) of invertebrate animals (e.g. sea stars, crabs, sea urchins, jellyfish) are noted, count all dead organisms. If there are more than 100, estimate the number to the nearest 100. Invertebrates counted should be restricted to animals larger than 5 cm (about 2 inches or larger than a silver dollar). This would exclude clam and mussel shells, small crustaceans, etc. If organisms can not be identified to species, then photograph or collect at least 3 representative specimens for later identification
Observers: *Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:

Position = lat/long, waypoint number, or recorded on map
Number of animals = 10 to 100 (count all animals), > 100 (estimate the number to the nearest 100)

Taxon	Position (Lat/Long) or (waypoint)	Number of animals	Photo No

Comments:			

Beach wrack

Algae and seagrasses that are deposited on the beach form a wrack or line of drift at the storm tide and high tide lines.

Observers:

*Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:

Percent (%) by volume defined as:

>75%

1 to 75%

Present but less than 1 %

Absent

Bull kelp	Dragon Kelp	Eelgrass	Giant Kelp	Other brown kelp	Red/green algae	Rockweed	Surfgrass	Other

Comments:								

Man-made structure, large debris, and human activities

Buildings, docks, rip-rap and other erosion control structures, pipelines, outfalls, wrecked boats, aircraft, refrigerators, autos, vehicles parts, garbage or refuse dumps, camps, coaling sites, horseback riding areas, areas for harvesting of clams or other marine resources, archeological sites, and other.

Observers:

*Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:

Position = lat/long, waypoint number, or recorded on map

Description	Position	Photo Number

Comments:		

Small debris on keeper beaches			
Observers: *Note – Provide address, phone number, and email if not on file			
Date:		Region:	
Estimates of volume = no. of 33 gal trash bags collected			
Keeper Beach Number:	Boundaries (Lat):	Boundaries (Long):	Photo No.
Fishing/boating gear:		Plastic containers:	
Glass containers:		Metal containers:	
Misc. containers		Other:	
Comments:			
Keeper Beach Number:	Boundaries (Lat):	Boundaries (Long):	Photo No.
Fishing/boating gear:		Plastic containers:	
Glass containers:		Metal containers:	

Misc. containers		Other:	
Comments:			
Keeper Beach Number:	Boundaries (Lat):	Boundaries (Long):	Photo No.
Fishing/boating gear:		Plastic containers:	
Glass containers:		Metal containers:	
Misc. containers		Other:	
Comments:			

Novel Debris All novel drifting debris on each segment that may be used to track ocean currents. These should include rubber bath toys, hockey gloves, Nike shoes, and logs with plastic tags, plastic Japanese survey stakes, and any other novel items that might have recently been spilled from cargo vessels.
Observers: *Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:
Boundaries (Lat):	Boundaries (Long):	Photo number:

Type of novel debris	Number of items

Comments:	

<table>
<tr><td colspan="5">Herring Spawn

Herring spawn can be identified as opalescent egg masses attached to algae, sea grasses, rocky substrata, or debris</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Observers:

*Note – Provide address, phone number, and email if not on file</td></tr>
<tr><td>Date:</td><td colspan="2">Region:</td><td colspan="2">Segment or

Zone No.:</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Substrate = rockweed, other brown algae, green or red seaweed, seagrass, rock, debri, man-made structure</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Boundaries (Lat/Long)</td><td>Cover

H = >75%

M = 25 to 75%

L = <25%</td><td>Thickness

H = >2cm

M = 0.5 to 2cm

L = <0.5cm</td><td>Substrate</td><td>Animals feeding on spawn</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
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</table>

Geomorphologic Change

Major geomorphologic changes to the shoreline that have occurred over the past year will be noted. These are to include, for example: large slide areas, areas where beaches have eroded, or sites where marine sediments have accumulated. The type of change will be noted. Changes will be classified as follows: eroded by waves or currents, eroded by glacial action, slide or cliff failure, glacial sediment deposition, stream sediment deposition, marine sediment deposition, uplift due to earthquake, subsidence due to earthquake. The extent of the change will be described in terms of the linear extent (meters) of shoreline affected and the average horizontal extent (shift in the position of the high tide line in meters).

Observers:

*Note – Provide address, phone number, and email if not on file

Date:	Region:	Segment or Zone No.:

Changes will be classified as follows

eroded by waves or currents (EWC)	stream sediment deposition (SSD)
eroded by glacial action (EGA)	marine sediment deposition (MSD)
slide or cliff failure (SCF)	uplift due to earthquake (UPLFT)
glacial sediment deposition (GSD)	subsidence due to earthquake.(SDEQ)

Type of Changes (3 to 4 letter code listed above)	Position (lat/long, waypoint, or recorded on map)	Meters of shoreline affected (linear extent in meters)	Average horizontal extent (Shift in position of high tide line in meters)

Changes will be classified as follows	
eroded by waves or currents (EWC)	stream sediment deposition (SSD)
eroded by glacial action (EGA)	marine sediment deposition (MSD)
slide or cliff failure (SCF)	uplift due to earthquake (UPLFT)
glacial sediment deposition (GSD)	subsidence due to earthquake.(SDEQ)

Type of Changes (3 to 4 letter code listed above)	Position (lat/long, waypoint, or recorded on map)	Meters of shoreline affected (linear extent in meters)	Average horizontal extent (Shift in position of high tide line in meters)

Comments:			

NPS 953/107700, Month Year

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov